IMPROVING DESIGN EFFICIENCY AND ACCURACY USING 3D MODELING• OTEC 2018













OHIO DEPARTMENT OF TRANSPORTATION

OCTOBER 3, 2018

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IMPROVING DESIGN EFFICIENCY AND ACCURACY USING 3D MODELING

Mike Taricska, PE

Burgess & Niple, Inc.

Katie Montoya

ODOT District 6

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INTERSECTION INFORMATION

- SR 61, SR 656, Wilson Rd in Delaware County
- Posted 55 mph
- Developing area

Image courtesy of Google

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CRASH HISTORY

- 32 crashes from 2014 - 2016, including injuries and 1 fatal
- Skew
- Crest/Sag Combo

Image courtesy of Google

POTENTIAL SOLUTIONS

- 5 alternatives studied and presented to public
  - No Build
  - 4-way Stop
  - Signalization
  - Roundabout
  - SR 61 Profile adjustment
- Roundabout chosen

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PROJECT GOALS

- Project Goals
  - Single-lane roundabout
  - Limit R/W at NW and SE quadrants (existing homes)
  - Improve vertical geometry approaching intersection
- Guidelines
  - NCHRP Report 672
  - ODOT L&D Volume 1

ROUNDABOUT CONCEPTS

- 3 Roundabout Designs Investigated
  - Standard, Oval, Peanut

ROUNDABOUT PERFORMANCE CHECKS – PEANUT SHAPE

- Peanut Roundabout chosen
- Improved roundabout geometry
  - Fastest Path
  - Phi Angles
  - Angle of visibility
  - Intersection skew

FASTEST PATH

- Encourage slow vehicle speeds
- Turn movements
  - Thru = R1-R2-R3
  - Left = R4
  - Right = R5

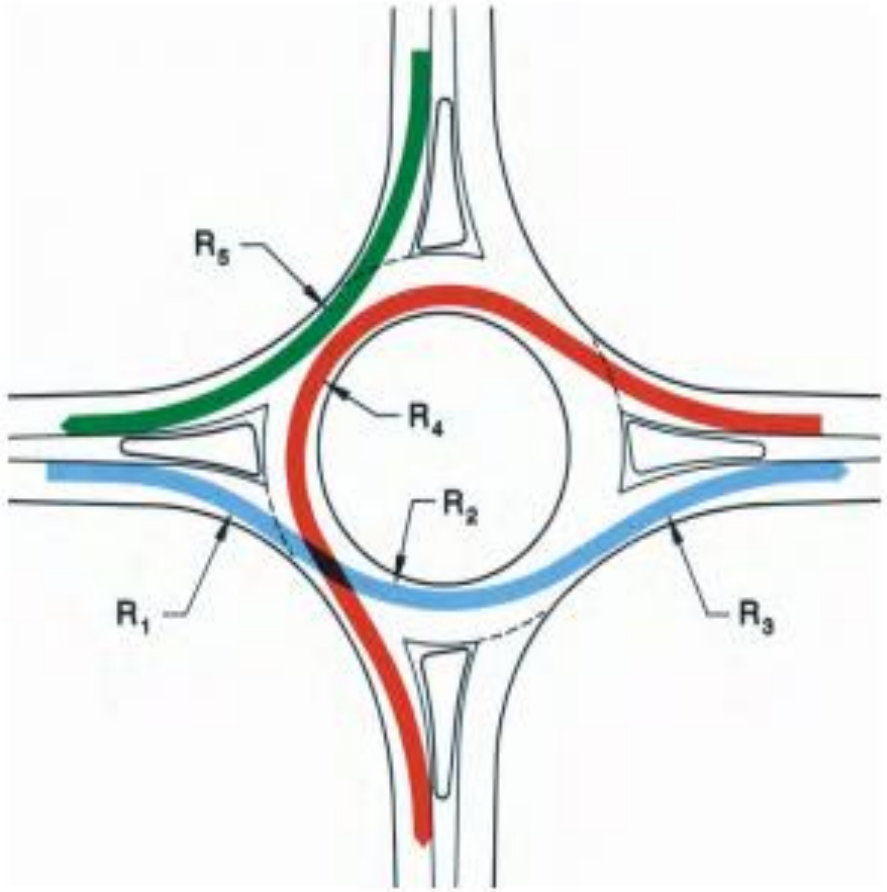
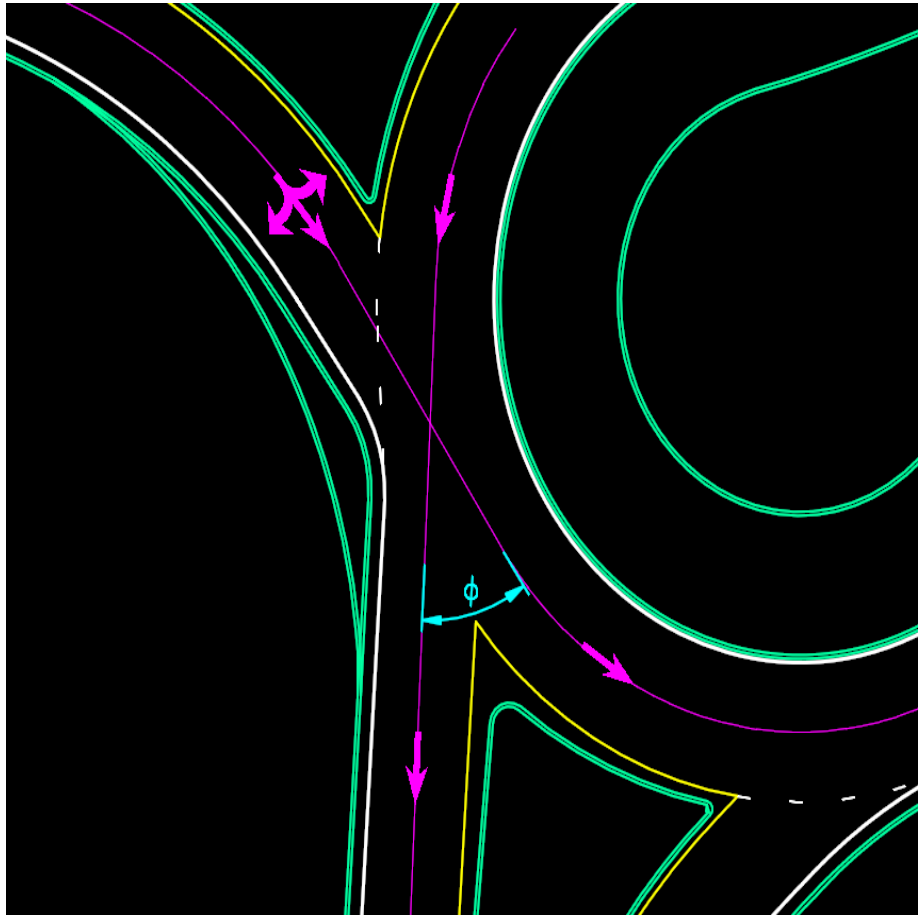


Image courtesy of NCHRP 672

PHI ANGLE

- Angle between approach to crossing departure
- 20° - 30° preferred
- Short (~3’) tangent at approach

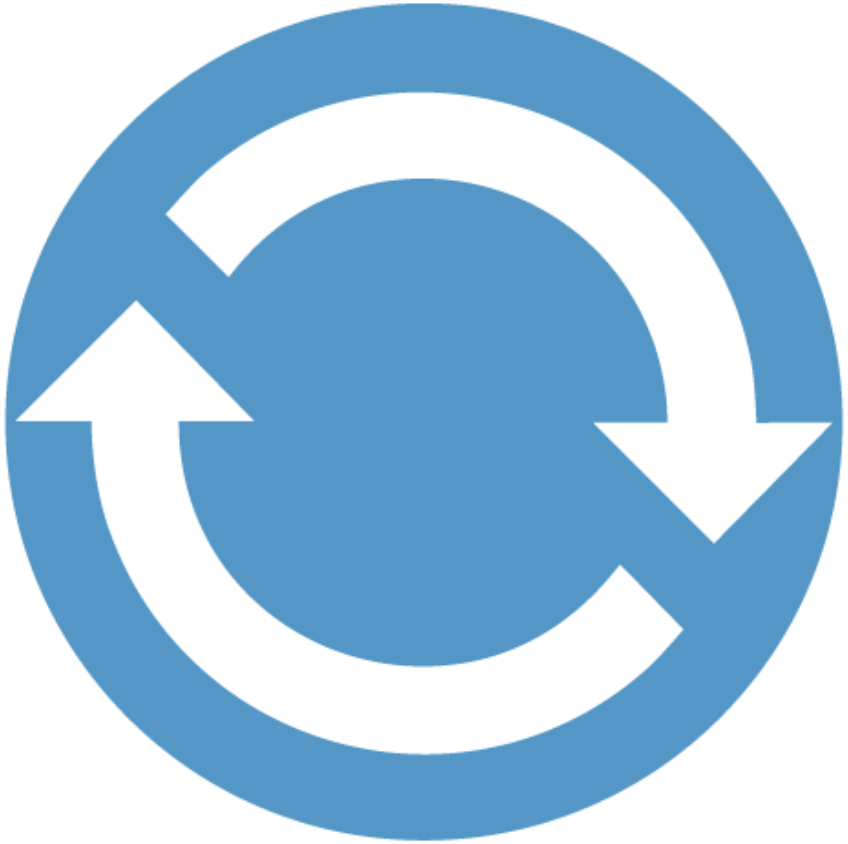


SWEPT PATH ANALYSIS (TRUCK TURNS)

- WB-62 design vehicle
- Drives truck apron placement/size
- Check for tractor weight shift

OPENROADS

- Roundabout design is iterative
  - Performance checks
  - Swept path (truck turns)
  - Minimize footprint
- OpenRoads = greater design efficiency

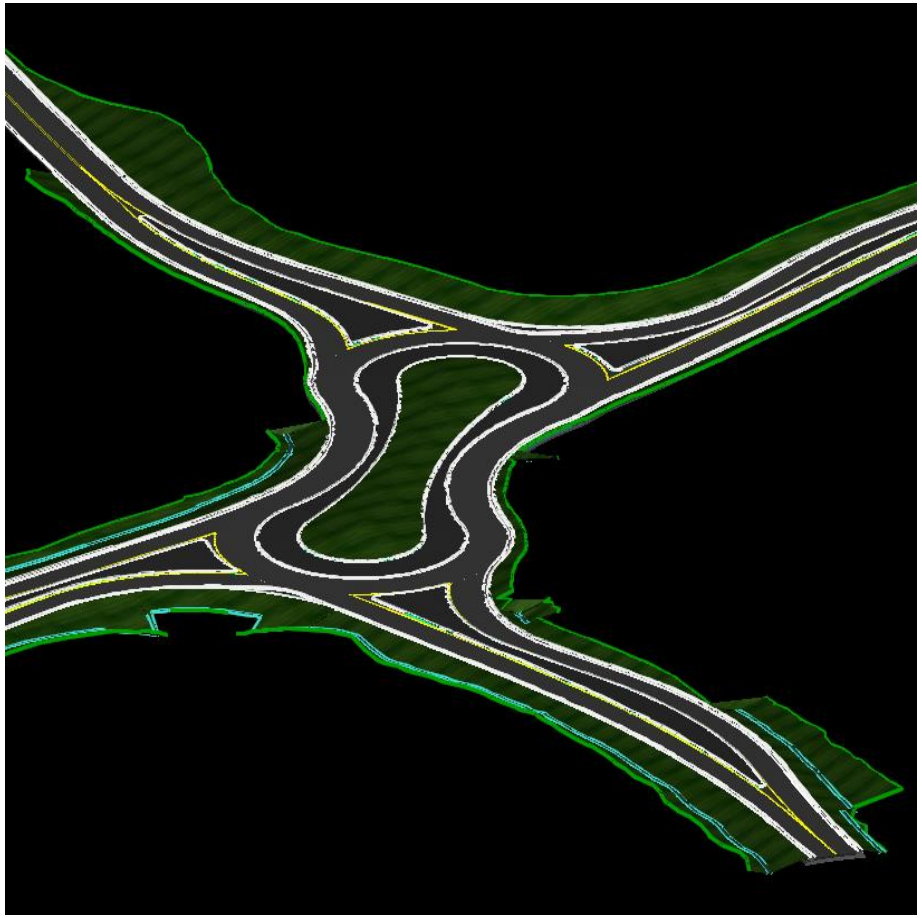


OPENROADS (SS4)

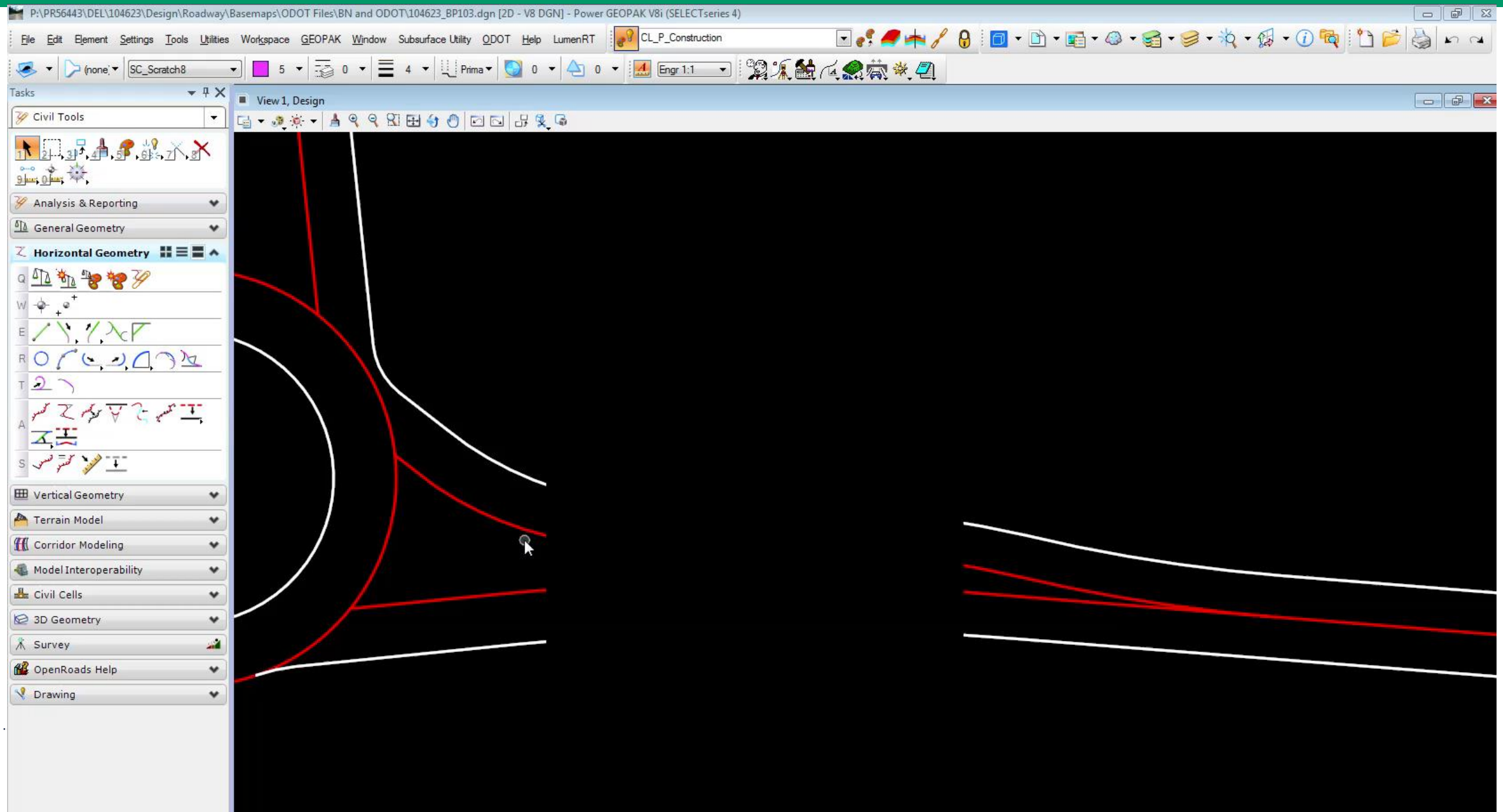
- Can be used on any type of project
- Best used in iterative design
- Greater efficiency
- Three conceptual roundabout layouts (horizontal, vertical, 3D model) in ***one week***

OPENROADS

- OpenRoads and detailed design
- Microstation Add-in
  - “Smart” linework
  - 3D emphasis
- OpenRoads = Select Series 4



OPENROADS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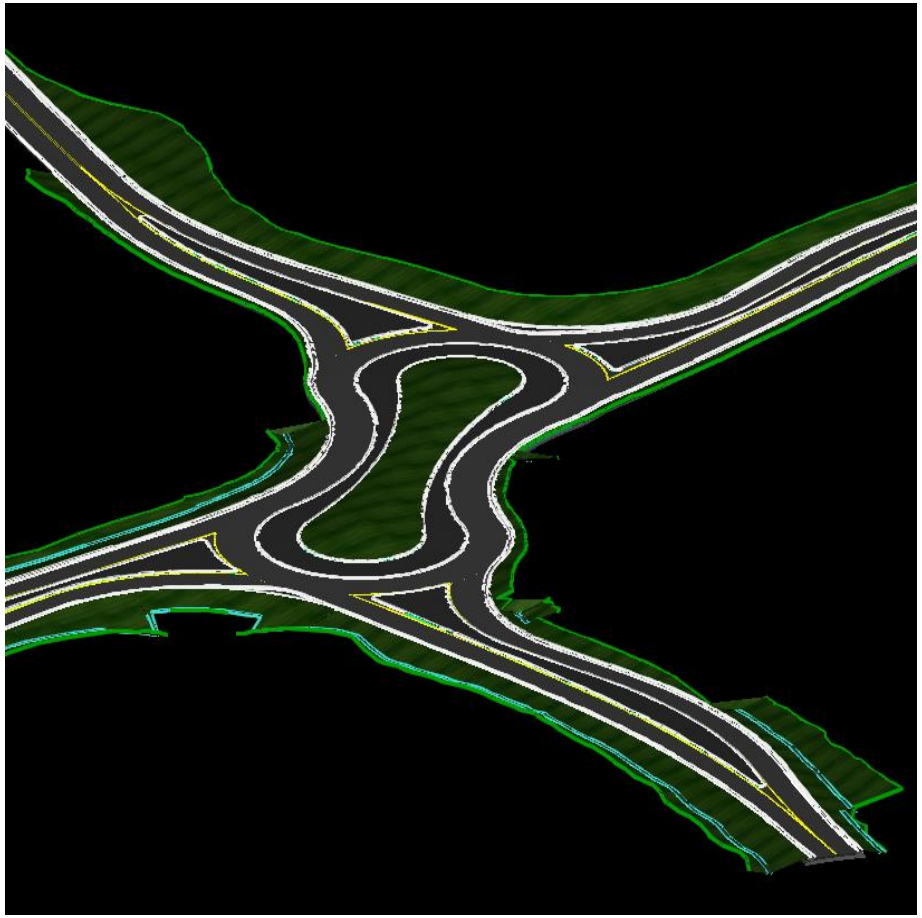
File Edit Element Settings Tools Utilities Workspace GEOPAK Window Subsurface Utility ODOT Help LumenRT
CL_P_Construction
SC_Scratch8
Engr 1:1
Tasks
Civil Tools
Analysis & Reporting
General Geometry
Horizontal Geometry
Vertical Geometry
Terrain Model
Corridor Modeling
Model Interoperability
Civil Cells
3D Geometry
Survey
OpenRoads Help
Drawing
View 1, Design

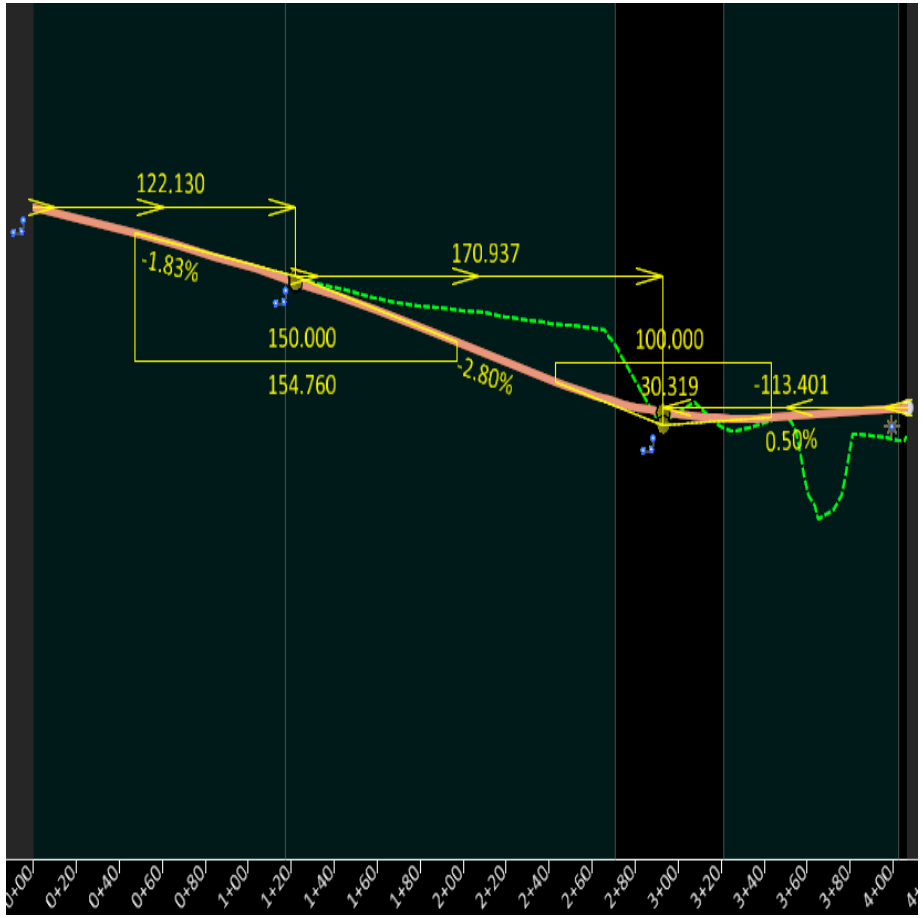
OPENROADS AND 3D MODEL

- Developed using OpenRoads
- *Can be used for…*
  - Conceptual quantities for cost estimate
  - Drive simulation
  - Cross sections and elevations in detailed design



PROFILES

- Graphical profile design
- Relate horizontal to vertical
- Linked profiles
- 3D linestring built automatically



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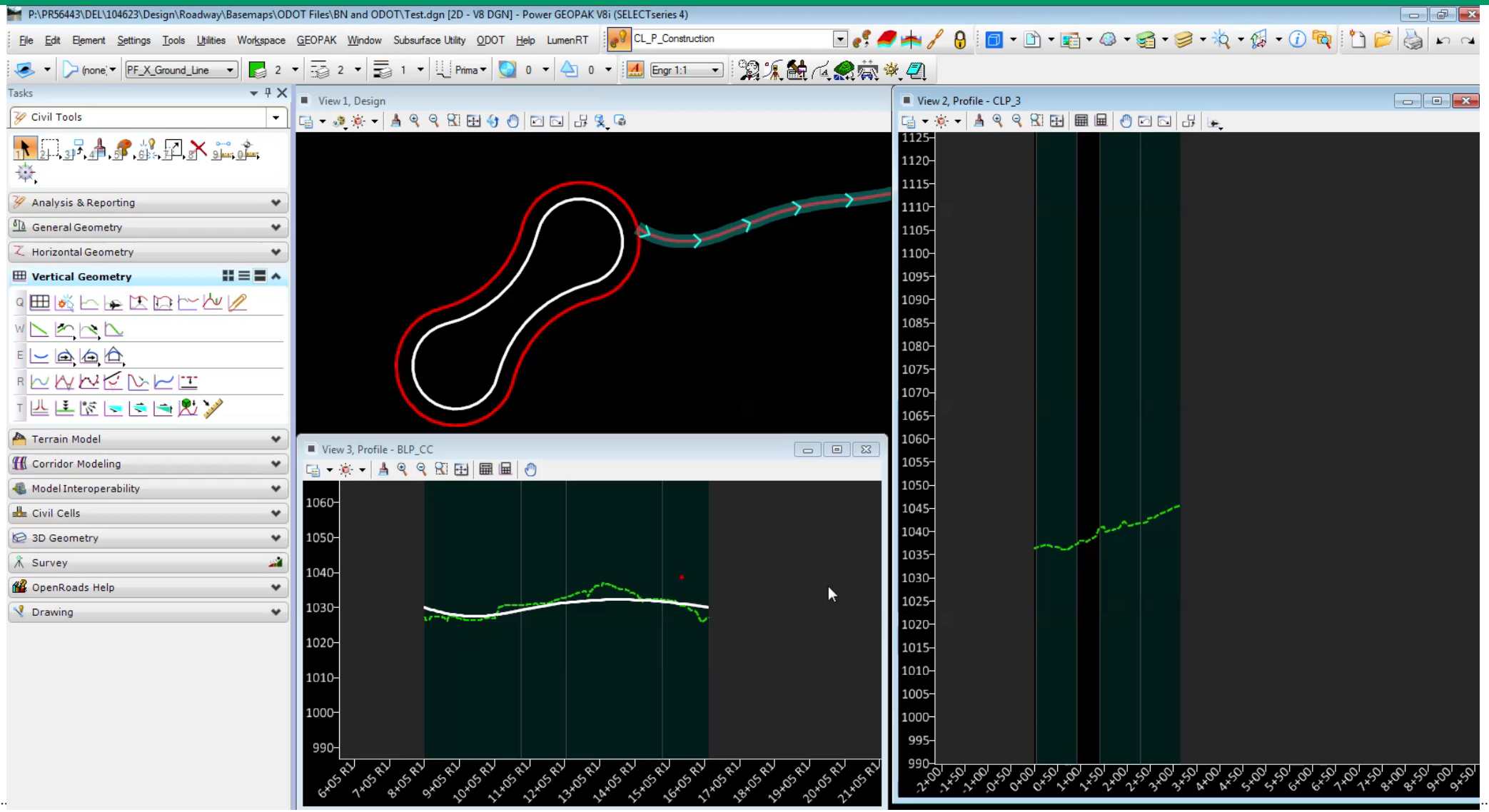
PROFILES



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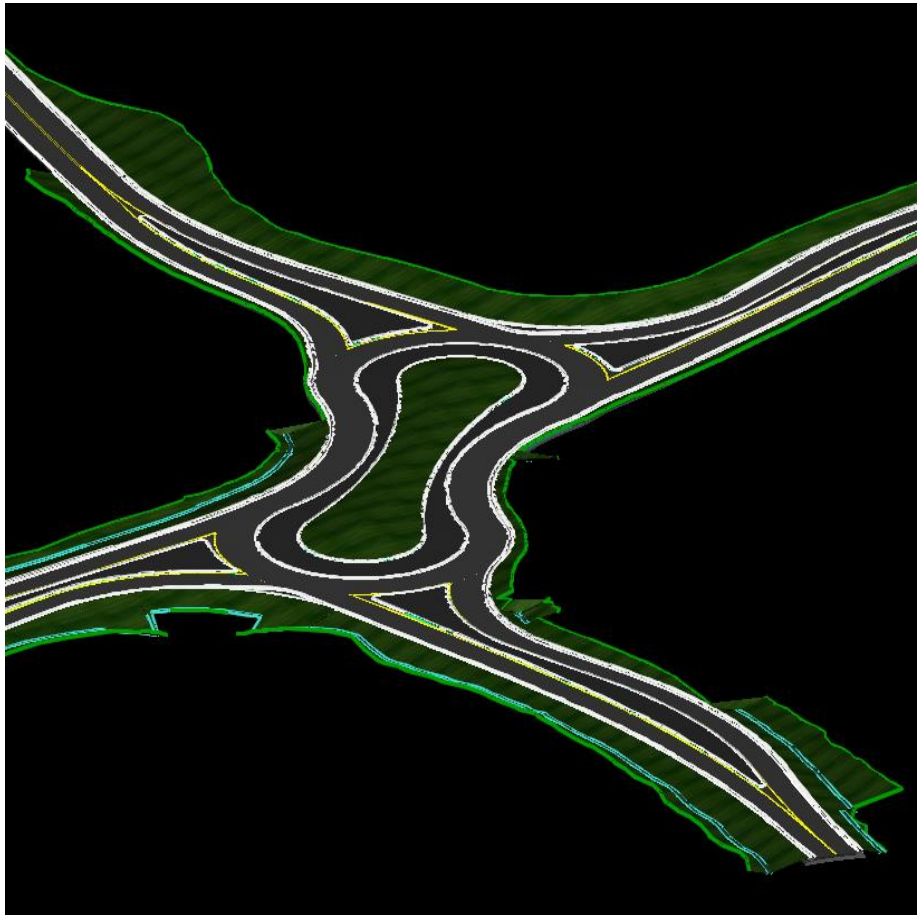
STAKEHOLDER ENGAGEMENT

- Key Stakeholders
  - ODOT District 6
  - DCEO
  - Kingston Township
- 3D Model and OpenRoads

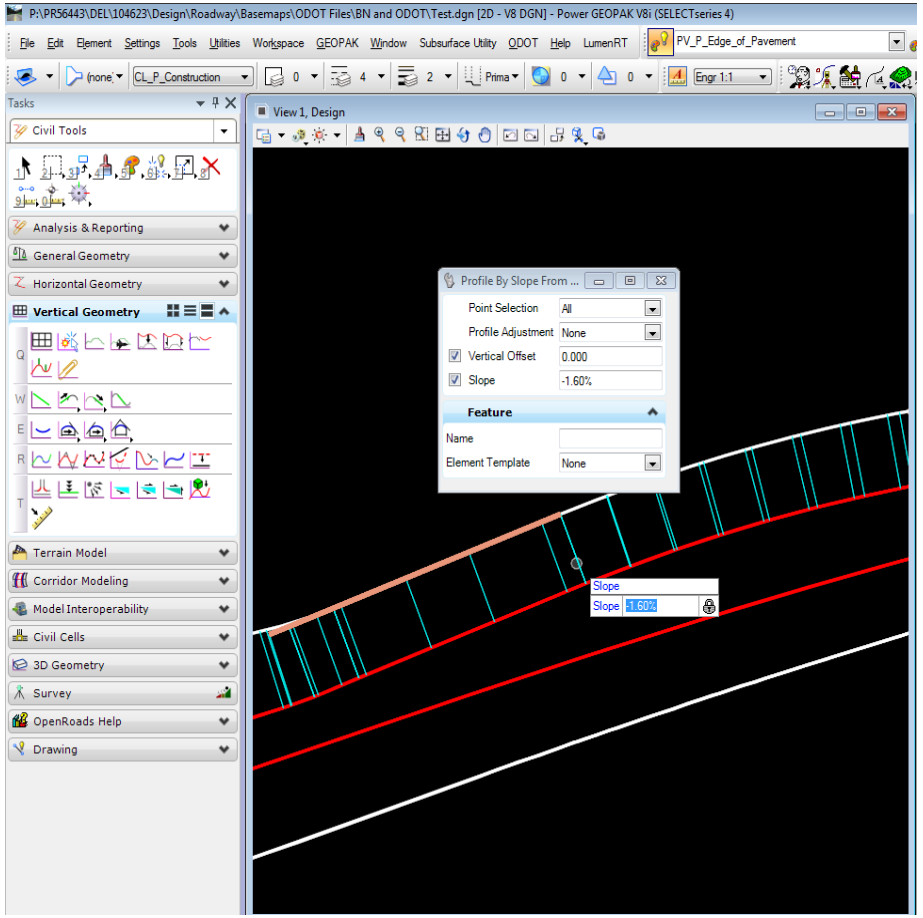
BUILDING THE 3D MODEL

- Two 3D modeling methods:
  - Corridor Modeling
  - Terrain Modeling
- Both methods create same output



BUILDING THE 3D MODEL

- Define pavement elevations from baseline profile
- 3D elements built once profile defined
- 3D = H+V



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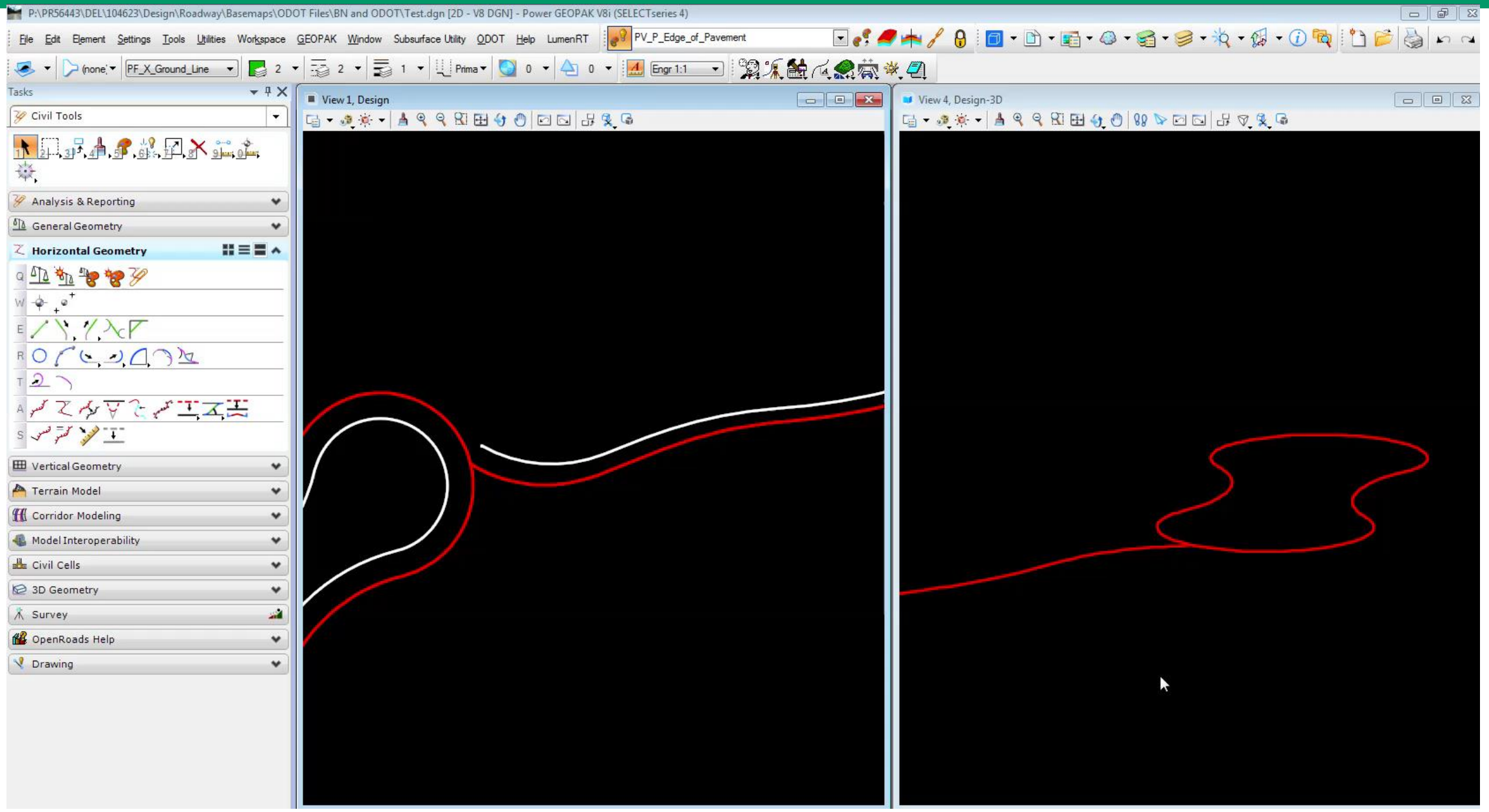
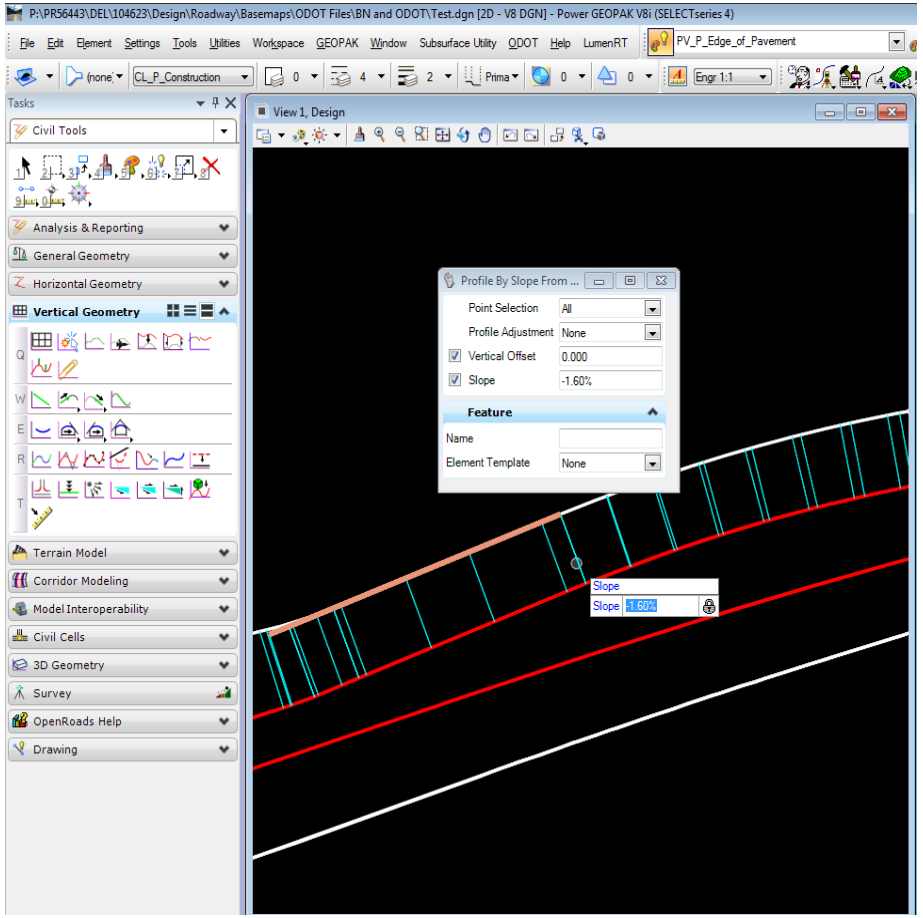
BUILDING THE 3D MODEL



BUILDING THE 3D MODEL

- Develop curb, grading, etc. from templates
- Pavement buildup applied from surface



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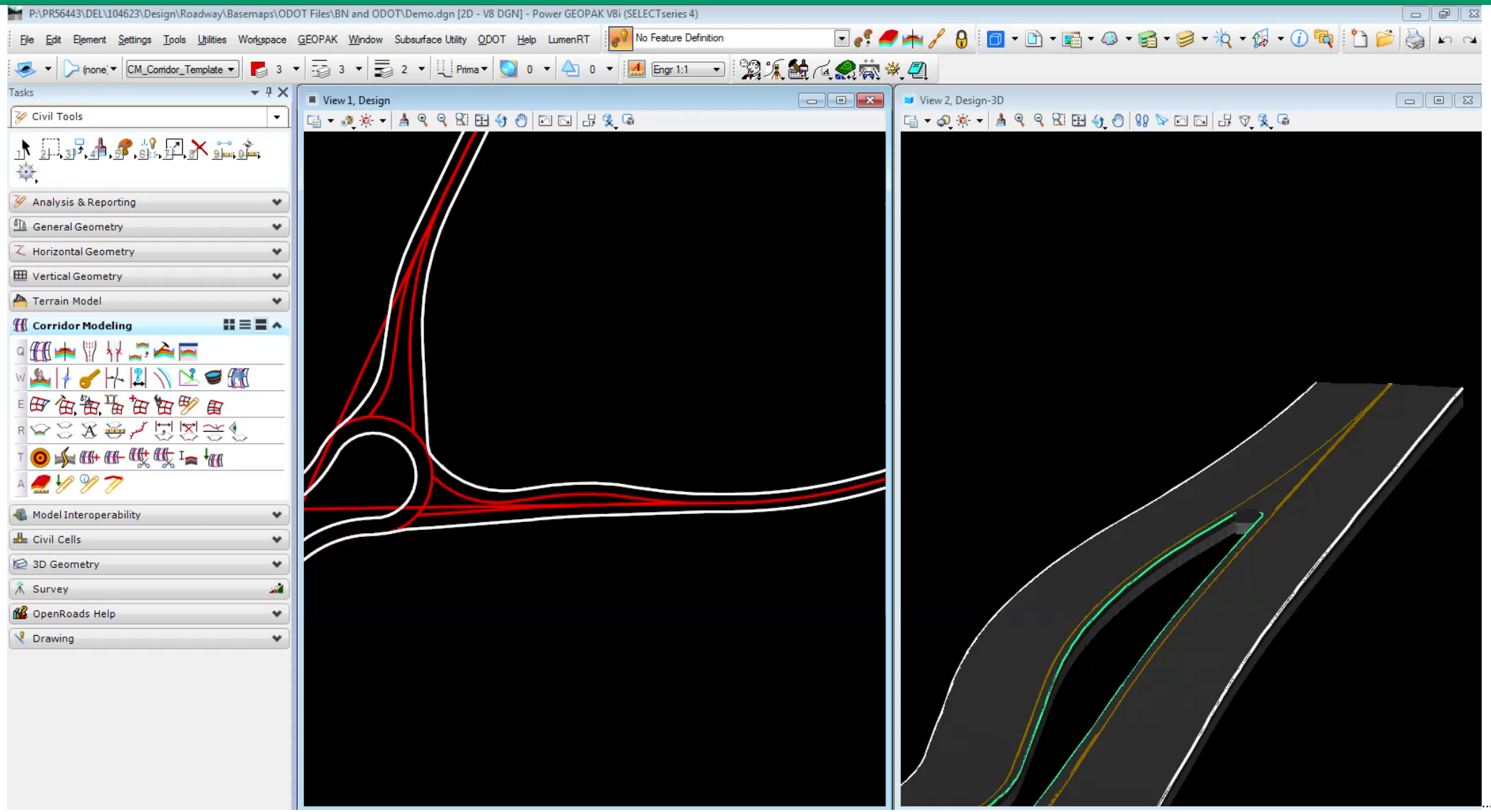
BUILDING THE 3D MODEL



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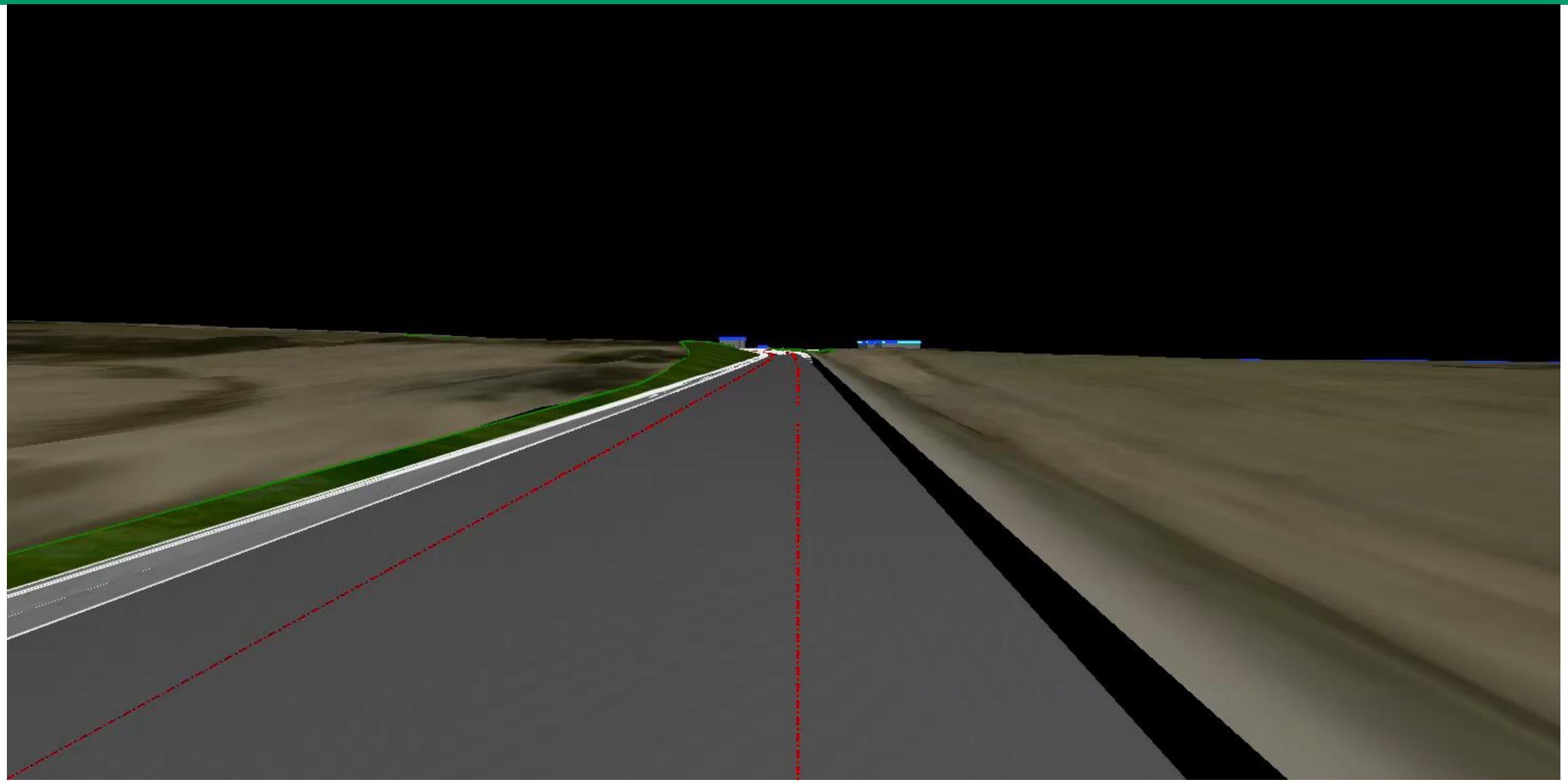
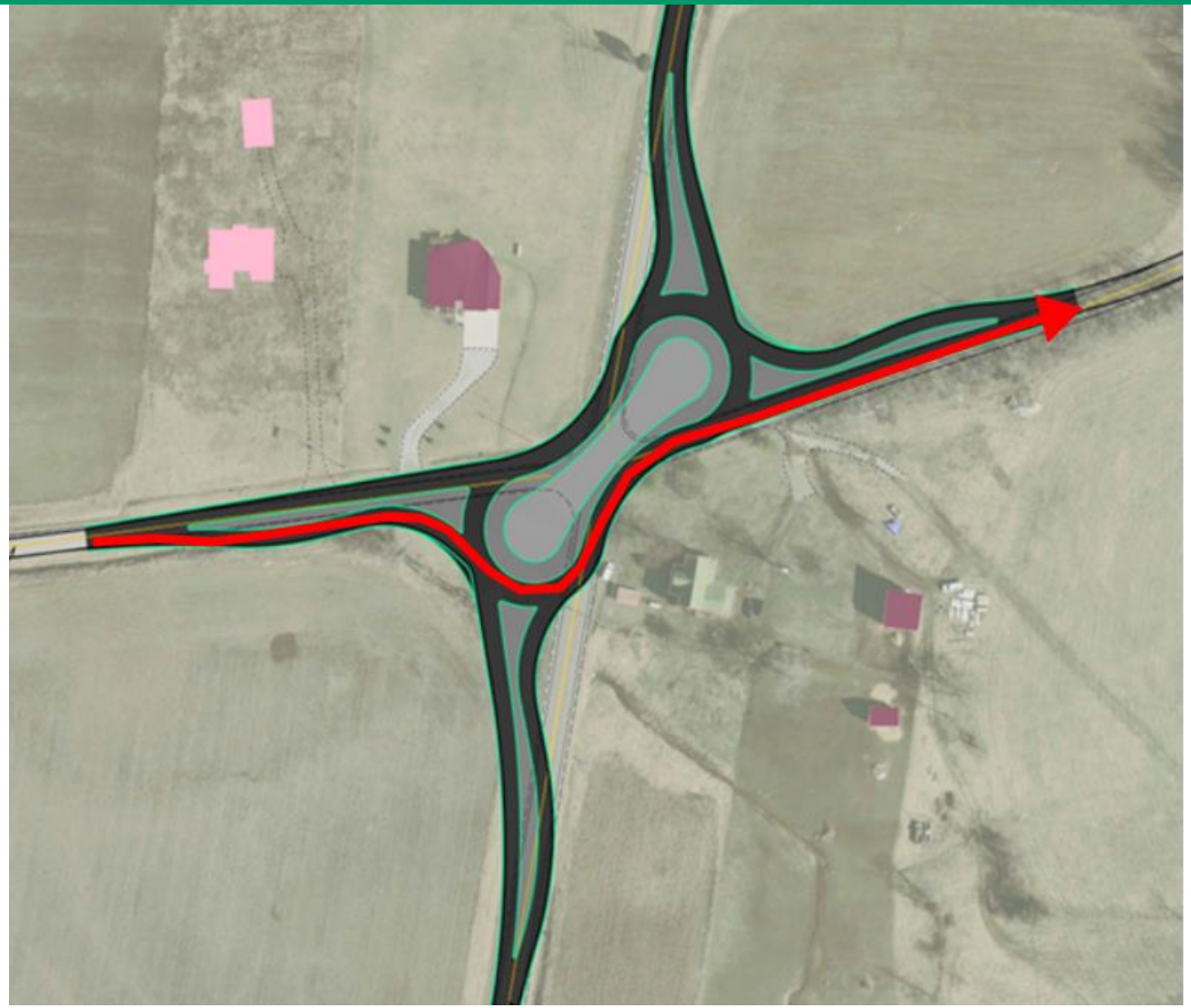
SOUTHBOUND THROUGH MOVEMENT – 3D MODEL

SOUTHBOUND THROUGH MOVEMENT



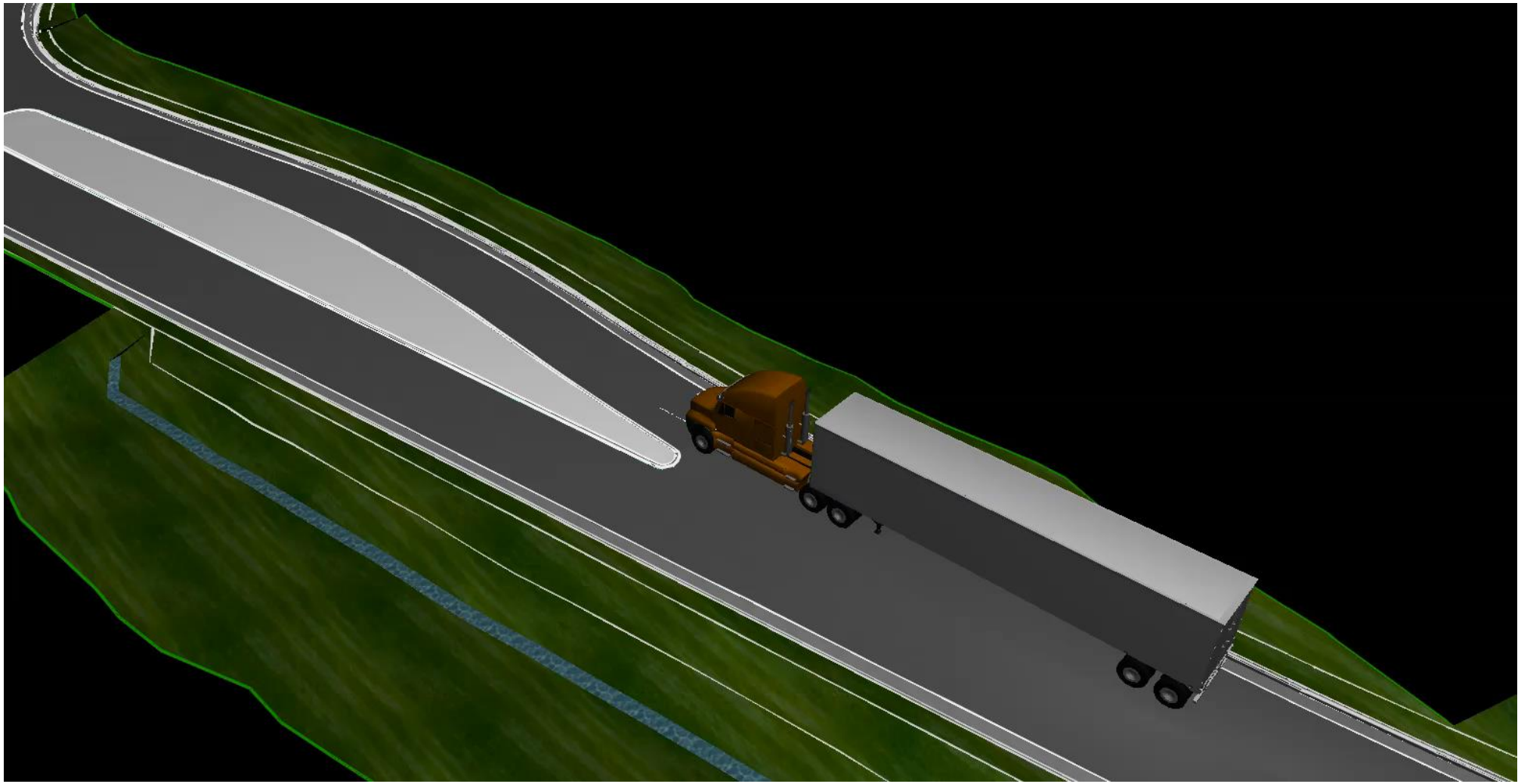
EASTBOUND THROUGH MOVEMENT – 3D MODEL



EASTBOUND THROUGH MOVEMENT

WESTBOUND LEFT TURN MOVEMENT – AUTOTURN

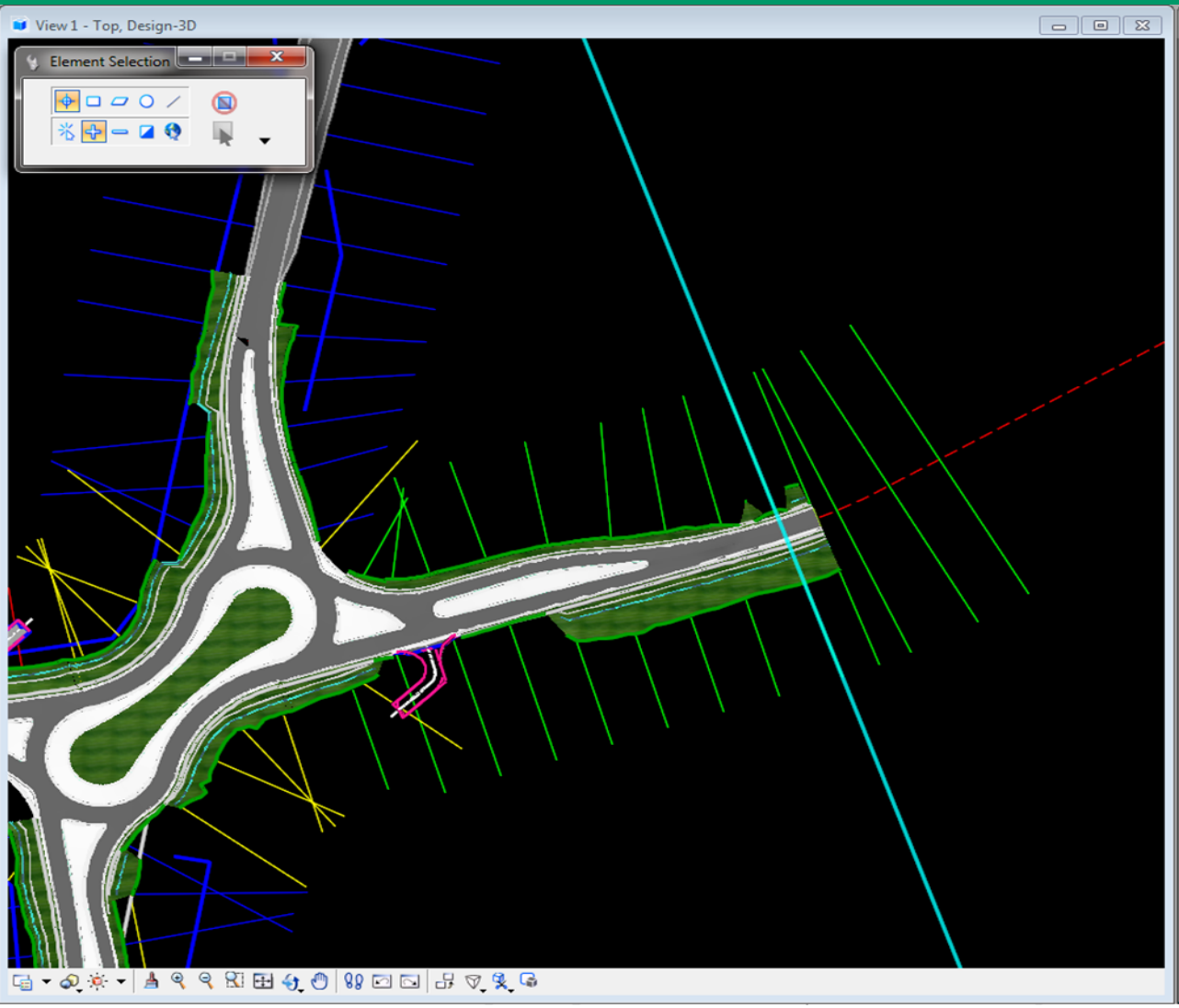
WESTBOUND TO SOUTHBOUND

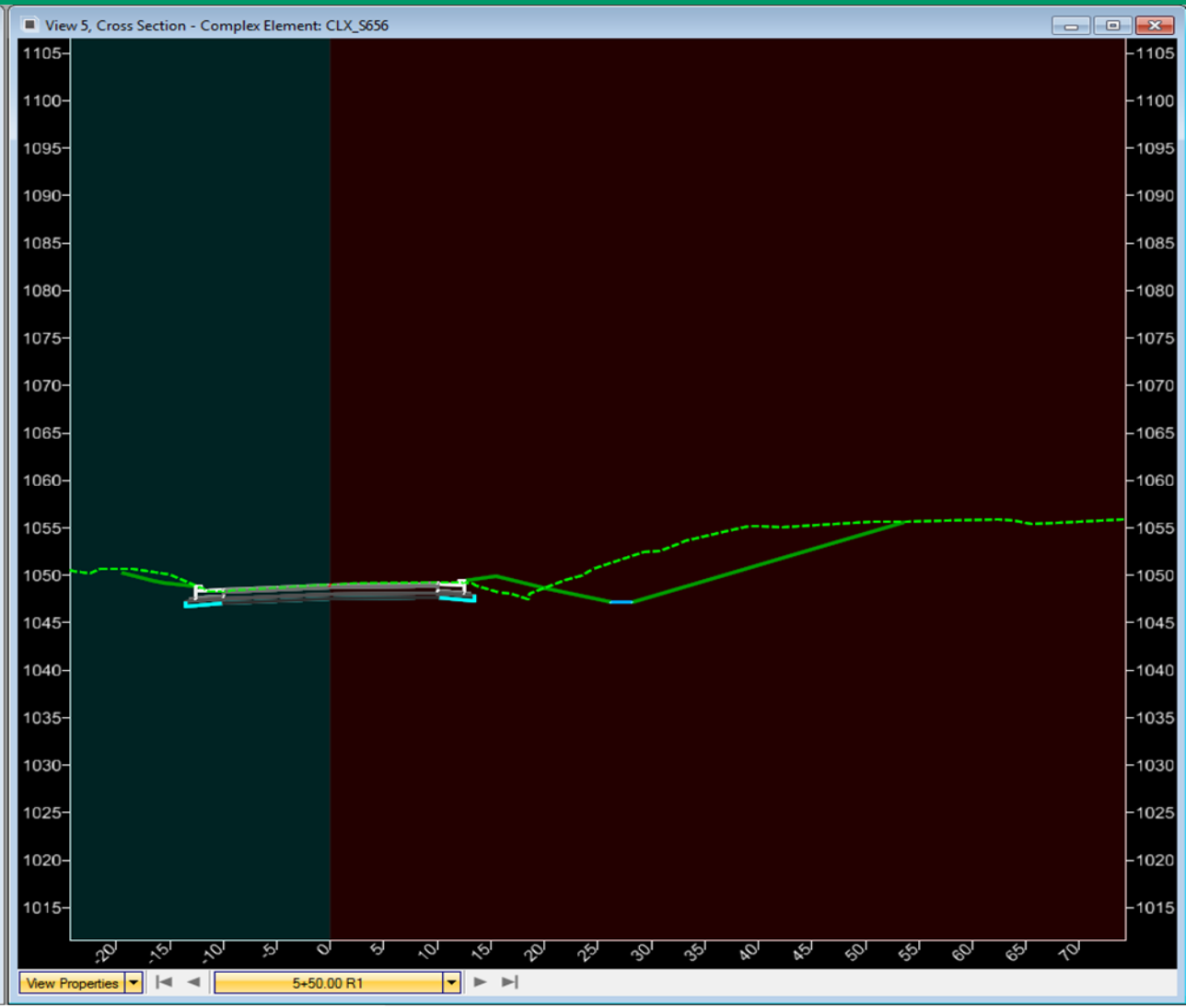


CROSS SECTIONS

- Cut from 3D model(s)
- Viewable during design iterations
- Functions as SS2
  - T-cell
  - Active chain control
  - Cross section sheets
- Can cut non-perpendicular sections

CROSS SECTIONS





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OPENROADS AND 3D MODEL

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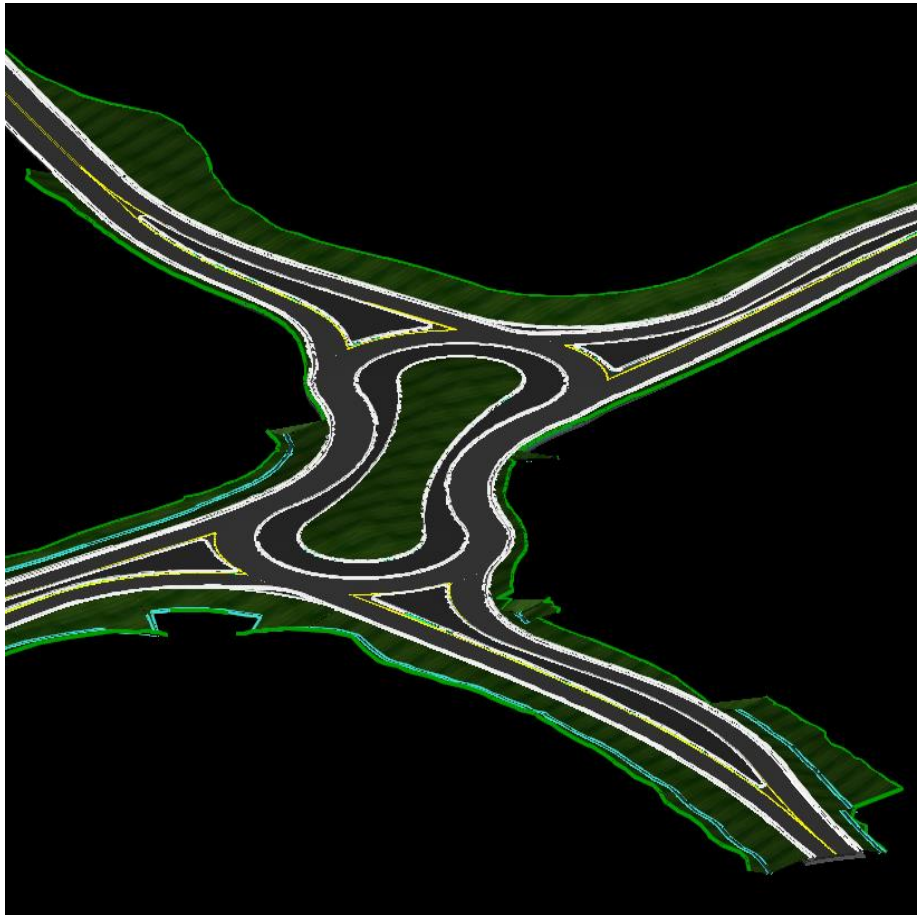
OPENROADS FOR QUALITY CONTROL

- 3D model = real time design quality check
- Linked profiles to ensure vertical tie-ins match



PROJECT WORKFLOW – GEOPAK SS2

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PROJECT WORKFLOW – OPENROADS (SS4)

KEY TAKEAWAYS

- OpenRoads improves efficiency in iterative design
- 3D models improve clarity of design and accuracy

QUESTIONS

Last updated 9/28/2018

CONTACT US

Mike Taricska, PE

Burgess & Niple, Inc.

mike.taricska@burgessniple.com

(614) 459-7272

Katie Montoya

ODOT District 6

katherine.montoya@dot.ohio.gov

(740) 833-8236

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